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EMBRYOLOGY.[1]

The Development of an Eight-limbed Vertebrate.—It is now some months since I communicated my suspicions to several friends that the so-called fan-tailed race of gold-fishes (*Carassius*) represented a type with four pairs of ventral limbs. Within a few days, through the courtesy of friends, I have been the surprised recipient of an admirable memoir by S. Watase, of the Imperial University of Japan, entitled "On the Caudal and Anal Fins of Gold-fishes," in which the author gives a full account of the osteology and development of the frequently double anal and caudal of the breeds "Riukin" and "Maruko," as they are known to the Japanese.

The author shows that the embryos developed a series of double ventral limb-folds extending from beneath the yelk-sac as far back as the end of the notochord and future urostyle. These folds being formed by an apparent median division of the ventral and caudal folds of the usual type seen in Teleostean embryos, the two resulting folds having shifted outwards somewhat from the median line towards the lateral position occupied by the rudiments of the anterior paired fins. This double or paired character of the ventral fold is also very pronounced in the preanal region, so that the two folds are serially continuous with the still more anterior rudiment of the "ventral" fin. The system of folds are entirely hypaxial, including even those which lead to the development of a double caudal, as in all Teleosts.

Tracing these very remarkable changes, Mr. Watase found that the interhæmal and the small basilar interhæmal nodules, supporting the rays of the anal and caudal, were repeated and paired the same as the folds in the embryos, and that even the hæmal arches of the caudal vertebræ were divergent from the median line instead of convergent towards it as in other Teleosts. In this manner both the anal and caudal paired fins are articulated by a chain of bones to the vertebral column. It is probable, however, that were the body cavity extended beyond the anus the anal pair would be severed from direct articulation with the vertebral column in the same way as the ventral or preanal pair, where the bones of the pelvic girdle represent, according to Wiedersheim, a pair of elements derived from a series of fused interhæmal pieces.

The supports of the caudal are morphologically of the same character. There can, therefore, be little or no doubt that it is quite proper to regard the pelvic, anal, and caudal pairs of fins, in the singularly modified domesticated races of gold-fishes, as serially of the same morphological value, and that if pectorals and ventrals are to be considered as limbs, the caudals and anals must likewise, in this instance, be so considered. This type is the only vertebrate yet examined which possesses eight distinct appendages which may be legitimately considered as representing four pairs of limbs.

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[1] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania, Philadelphia.

It is a singular circumstance that the ventral fin-folds in the embryos described by Mr. Watase are not double in the region of the anus. In every other respect these remarkable forms furnish confirmation of Dohrn's view as to the nature of the median ventral fin-fold of fishes.

Mr. Watase describes four principal types or modifications of the development of the paired fins of these interesting fishes. Upon the whole, his memoir is one of the most interesting in its bearings upon morphology of the limbs of fishes which has appeared for many years.—*John A. Ryder.*

The Inversion of the Germinal Layers in Hesperomys.—During the past summer the writer has succeeded in obtaining early stages of the embryos of *Hesperomys*, which show that the germinal layers of this American genus of myomorphs are "inverted" as in the mouse. Fig. 1 serves to show how closely they resemble the early stages of the latter as figured by Selenka. Here *s* represents the suspensor (*Träger*); *d*, the *Deckzellen*, or outer layer; *h*, hypoblast; *e*, the epiblast, of which only that portion as far as the constriction, *c*, enters directly into the formation of the embryo. At *a* is seen the amniotic part of the cavity enclosed by the epiblast, and at *f* the secondary cavity, which at a later period is separated from the cavity of the amnion. The attachment of the blastosphere at one end by means of processes of the cells forming the outer layer of the suspensor, *s*, is well marked, and the blastosphere, as in *Mus*, *Arvicola*, and *Cavia*, is very considerably elongated. The embryonic part of the epiblast, *e*, is also thrust inwards towards the bottom or fundus of the blastosphere so as to obliterate the cavity of the yelk-sac, as in the other genera named.

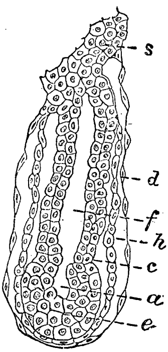

Fig. 1.

The relations of the blastosphere to the cavity of the uterus are also of some interest, as may be seen by reference to Fig. 2 (enlarged sixteen times), in which the greatly hypertrophied mucosa is represented at M, M, M, M in a cross-section of the uterus. Lying in an eccentric position in the section at *e* the minute embryo is apparent, while some distance from the embryo there is a hollow conical mass of tissue, *c*, which is part of the original epithelial wall of the tubular uterus, and is different from the much thickened and very spongy surrounding mucosa, the disposition of the lacunæ in which is indicated by the faint radiating lines. The relations of the embryo, *e*, to the original cavity of the uterine tube is better shown in Fig. 3, showing a longitudinal section of a portion of the uterus containing a single embryo. The cavity of the uterus, *u*, *u*, at either side of the region containing the embryo, is quite spacious, whereas towards the centre, *c*, of the gravid portion its lumen has been narrowed to a fine canal. On the upper or mesometric side the mucosa, M, is thinner, while on the lower side the uterine wall is much more thickened. In fact, there is evidence to indicate that the embryo, *e*, has been thrust down into the lower wall and become imbedded in one of the crypts of the mucosa. That this is true is indicated by the conical or funnel-shaped passage, *c*, which leads down towards the embryo from the middle of the narrowed portion of the uterine cavity, as shown in Fig. 3.

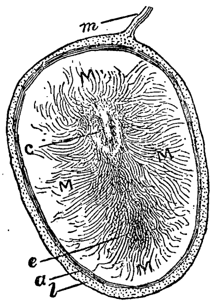

FIG. 2.

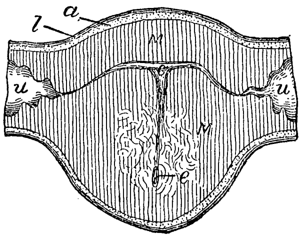

FIG. 3.

The eccentric position of the embryo in the thickened mucosa, as well as the specialized condition of the blastosphere, would favor the development of a discoidal placenta, but that the discoidal type is not the one which was characteristic of the ancestors of the *Rodentia* is, it seems to the writer, sufficiently indicated by the annular thickening of the mucosa around the embryo, for, towards the non-gravid portions of the uterine cavity at *u*, *u*, the mucosa becomes suddenly thinner. As in man, the main portion of the uterus to be first affected is its mucous lining, the muscular wall undergoing a slower and less marked change. The inner annular and outer longitudinal muscular coats of the uterus are indicated at *a* and *l* in Figs. 2 and 3; the mesometrium at *m*. The annular structure described in the preceding number of this journal is not yet well differentiated at this stage.—*John A. Ryder.*